REMARKS

Claims 1-35 and 37-42 will be in the application for further prosecution. Claim 36 has been cancelled. Claims 40-43 have been added. They find support at page 17, lines 18 to 24 and page 7, lines 15-17. Claims 1-4, 12-16, 18, 20, 21-24, 25-30, and 31-35 have been amended to further distinguish the present invention from the cited references, which are discussed below.

Claims 4 and 6-20 have been rejected under 35 U.S.C. 112 as indefinite for lacking a description of how the structure is used. In response, the Applicants have amended Claims 4, 18, and 20 to emphasize the process aspects, which should obviate the rejections as to those claims. Claims 6-17, and 19 have not been amended, except as needed to conform to amended Claims 1-4. These claims include all the limitations of the claims from which they depend and thus only add a description of preferred structures. Thus, these claims should not be considered indefinite, but merely more limited by including characteristic properties of the microfluidic device. Consequently, reconsideration of the rejection of Claims 6-17 and 19 is requested.

Claims 25-28, 29-30, and 36 also have been rejected under 35 U.S.C. 112 as indefinite. Claims 25-28 have been amended to substitute "liquids" for the word "containers". It should now be clear that the volume of the chambers can be determined since they are related to the volume of the liquids to be mixed. Claims 29-30 also have been amended to make it clear that the volume of the first and second chambers can be established with respect to the volume of the liquids to be mixed. Claim 36 has been cancelled, although it is likely that one skilled in the art could determine the dimensions of a capillary passageway once the related design parameters have been established.

Claims 1-4, 20, and 21-24 have been rejected under 35 U.S.C. 102(e) as anticipated by Koop et al ("Koop") U.S. 6,457,854. The Applicants do not agree that Koop anticipates these

claims, since Koop discloses a very different device and method. To clarify the differences, Claims 1-4 and 21-24 have been amended to make it clear that when more than one passageway is used they are separated, as will be clear from the drawings. If Koop anticipated, then if later in time Koop would infringe the present claims, but it could not. Alternatively, all the elements of the present claims must be present in Koop and they are not. Koop contains no first and second chambers, connected through one or more separated capillary passageways. Instead, Koop uses two passageways that intersect many times to mix two liquids. Therefore, the Applicants' invention is not anticipated by Koop's mixing device.

In order for microfluidic devices to carryout analysis of liquid samples, it is often necessary to mix liquids. However, it is well known that liquids flowing in capillary passageways are in laminar flow, as explained at page 2, line 24 to page 3, line 5. Therefore, the liquids tend to remain separate rather than mix. Consequently, many devices, such as those discussed at page 3, line 12 to page 5, line 7, attempt to overcome the problem, often by improving diffusion between parallel-flowing liquids. In the Applicants' microfluidic devices the chambers are connected by capillary passageways in which flow is expected to be laminar and thus mixing would not be expected. However, the Applicants found that mixing can be achieved when liquids are combined in one chamber and then moved through one or more connecting capillaries to a second chamber. The principles involved are discussed at length at page 13, line 12 to page 18, line 18. Certain factors are believed to result in mixing, as the liquids exit one chamber and exit the capillary(ies) into the second chamber. With regard to the preferred features, such as the space left in the chambers when filled with liquids, or the dimension of the capillaries, or the addition of microstructures to improve mixing, these can be

seen to be significantly different from the device described by Koop, which may or may not be properly considered a micro fluidic device.

Koop shows a mixing device without describing the dimensions of the passages. If they are capillaries, then they will be subject to the problems associated with laminar flow, but there is no indication that the Koop device was intended to cope with those problems. Furthermore, there is no indication that capillary forces are operative in the Koop device. The devices illustrated in Koop appear to require that the liquids are introduced under external pressure and are forced through the intersecting sinusoidal passageways to cause the liquids to mix. In contrast, the Applicants device moves liquid through passageways by capillary forces except when a capillary stop must be overcome (see page 8, lines 15-17). In many cases, the passageways will be hydrophilic and liquids being mixed wet the surfaces. Koop makes no reference to a need to adjust the surface energy of his passages.

No chambers are used by Koop. It would not be reasonable to treat the intersection of the passageways as a chamber corresponding to those shown by the Applicants. In the Applicant's device, the movement of liquids between small capillary passages and relatively larger chambers contributes to the mixing that occurs (see page 13, lines 21-26). Finally, Koop's reference to addition of other mechanical devices at column 3, lines 26-34 further suggests that, although designated as a "micromixer", his device should not be properly classified with the Applicants' microfluidic device.

Claims 6-16, 18-19, 25-36, and 38 have been rejected under 35 U.S.C. 103(a) as unpatentable (i.e. obvious) over Koop. Each of these claims depends from independent Claims 1 or 21 and should be allowable if the independent claims are allowed. The Applicants contend that Claims 1 and 21 are not anticipated by Koop, but also that they should not be obvious. If

Koop teaches forcing two liquids into intersecting sinusoidal passages, it does not follow that one skilled in the art would substitute two chambers connected by one or more separated capillary passageways, since laminar flow would be expected.

The subject matter claimed in dependent claims 6-16, 18-19, 25-36, and 38 is not properly within the "ordinary skill of the art," as the Examiner contends. Making such an extrapolation from Koop, who teaches a very different mixing device cannot be considered feasible. While it would be reasonable to make such an argument in some instances, it is not persuasive here, where the two devices are so different.

Claims 5, 17, 37, and 39 have been rejected under 35 U.S.C. 103(a) as unpatentable over Koop in view of Jakajima et al [sic] (Nakajima). The deficiencies of Koop have already been discussed. Nakajima described an improved device to create microspheres, which involved structures that are far different from those of the Applicants' device. Again, the Examiner relies on "obvious to one skilled in the art" to combine Nakajima with Koop. However, there is no suggestion anywhere that combining Nakajima with Koop would yield the Applicants' invention.

Many additional references were cited, but not applied against the present claims. None of these are believed to be more pertinent than those used by the Examiner. Many of these patents involve movement or separation of liquids by electromotive means, rather than mixing of liquids. Hillman et al discusses microfluidic devices in which liquids are moved by capillary action and mentions the use of sonication for mixing and vanes to create turbulence.

The Examiner is asked to reconsider his rejection and to allow the amended claims. If further amendment is believed necessary, the Examiner is invited to contact the Applicants' attorney, at the telephone number provided below.

Respectfully submitted,

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Date

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